

## PATENT COOPERATION TREATY

PCT

NOTIFICATION OF ELECTION  
(PCT Rule 61.2)

From the INTERNATIONAL BUREAU

To:

Commissioner  
US Department of Commerce  
United States Patent and Trademark  
Office, PCT  
2011 South Clark Place Room  
CP2/5C24  
Arlington, VA 22202  
ETATS-UNIS D'AMERIQUE  
in its capacity as elected Office

Date of mailing (day/month/year) 14 November 2000 (14.11.00)	
International application No. PCT/ES99/00382	Applicant's or agent's file reference 199.221/MAD
International filing date (day/month/year) 25 November 1999 (25.11.99)	Priority date (day/month/year) 18 January 1999 (18.01.99)
Applicant DÍAZ CARMENA, Ángel	

1. The designated Office is hereby notified of its election made:

in the demand filed with the International Preliminary Examining Authority on:

07 August 2000 (07.08.00)

in a notice effecting later election filed with the International Bureau on:

\_\_\_\_\_

2. The election  was

was not

made before the expiration of 19 months from the priority date or, where Rule 32 applies, within the time limit under Rule 32.2(b).

The International Bureau of WIPO 34, chemin des Colombettes 1211 Geneva 20, Switzerland	Authorized officer Olivia TEFY
Facsimile No.: (41-22) 740.14.35	Telephone No.: (41-22) 338.83.38

**PATENT COOPERATION TREATY**

From the  
INTERNATIONAL PRELIMINARY EXAMINING AUTHORITY

10/07/2013

**PCT**

NOTIFICATION OF TRANSMITTAL OF  
THE INTERNATIONAL PRELIMINARY  
EXAMINATION REPORT

(PCT Rule 71.1)

To:

UNGRIA LOPEZ, Javier  
Avenida Ramon y Cajal, 78  
E-28043 Madrid  
ESPAÑE

Date of mailing (day/month/year)		26.04.2001
<b>IMPORTANT NOTIFICATION</b>		
Applicant's or agent's file reference 199.221/MAD	International application No. PCT/ES99/00382	
	International filing date (day/month/year) 25/11/1999	Priority date (day/month/year) 18/01/1999
Applicant SOCIEDAD ESPANOLA DE ELECTROMEDICINA Y CALIDAD, SA		

1. The applicant is hereby notified that this International Preliminary Examining Authority transmits herewith the international preliminary examination report and its annexes, if any, established on the international application.
2. A copy of the report and its annexes, if any, is being transmitted to the International Bureau for communication to all the elected Offices.
3. Where required by any of the elected Offices, the International Bureau will prepare an English translation of the report (but not of any annexes) and will transmit such translation to those Offices.

**4. REMINDER**

The applicant must enter the national phase before each elected Office by performing certain acts (filing translations and paying national fees) within 30 months from the priority date (or later in some Offices) (Article 39(1)) (see also the reminder sent by the International Bureau with Form PCT/IB/301).

Where a translation of the international application must be furnished to an elected Office, that translation must contain a translation of any annexes to the international preliminary examination report. It is the applicant's responsibility to prepare and furnish such translation directly to each elected Office concerned.

For further details on the applicable time limits and requirements of the elected Offices, see Volume II of the PCT Applicant's Guide.

Name and mailing address of the IPEA/   European Patent Office D-80298 Munich Tel. +49 89 2399 - 0 Tx: 523656 epmu d Fax: +49 89 2399 - 4465	Authorized officer  Schuster-Kaechele, W Tel. +49 89 2399-2281
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## INTERNATIONAL COOPERATION TREATY

## PCT

## INTERNATIONAL PRELIMINARY EXAMINATION REPORT

(PCT Article 36 and Rule 70)

Applicant's or agent's file reference 199.221/MAD	<b>FOR FURTHER ACTION</b>		See Notification of Transmittal of International Preliminary Examination Report (Form PCT/IPEA/416)
International application No. PCT/ES99/00382	International filing date (day/month/year) 25/11/1999	Priority date (day/month/year) 18/01/1999	
International Patent Classification (IPC) or national classification and IPC H01F27/06			
<p><b>Applicant</b> SOCIEDAD ESPANOLA DE ELECTROMEDICINA Y CALIDAD, SA</p>			
<p>1. This international preliminary examination report has been prepared by this International Preliminary Examining Authority and is transmitted to the applicant according to Article 36.</p> <p>2. This REPORT consists of a total of 7 sheets, including this cover sheet.</p> <p><input checked="" type="checkbox"/> This report is also accompanied by ANNEXES, i.e. sheets of the description, claims and/or drawings which have been amended and are the basis for this report and/or sheets containing rectifications made before this Authority (see Rule 70.16 and Section 607 of the Administrative Instructions under the PCT).</p> <p>These annexes consist of a total of 11 sheets.</p>			
<p>3. This report contains indications relating to the following items:</p> <ul style="list-style-type: none"> <li>I <input checked="" type="checkbox"/> Basis of the report</li> <li>II <input type="checkbox"/> Priority</li> <li>III <input type="checkbox"/> Non-establishment of opinion with regard to novelty, inventive step and industrial applicability</li> <li>IV <input type="checkbox"/> Lack of unity of invention</li> <li>V <input checked="" type="checkbox"/> Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement</li> <li>VI <input type="checkbox"/> Certain documents cited</li> <li>VII <input checked="" type="checkbox"/> Certain defects in the international application</li> <li>VIII <input checked="" type="checkbox"/> Certain observations on the international application</li> </ul>			

Date of submission of the demand 07/08/2000	Date of completion of this report 26.04.2001
Name and mailing address of the international preliminary examining authority: European Patent Office D-80298 Munich Tel. +49 89 2399 - 0 Tx: 523656 epmu d Fax: +49 89 2399 - 4465	Authorized officer Meul, H Telephone No. +49 89 2399 2494



INTERNATIONAL PRELIMINARY  
EXAMINATION REPORT

International application No. PCT/ES99/00382

I. Basis of the report

1. With regard to the **elements** of the international application (*Replacement sheets which have been furnished to the receiving Office in response to an invitation under Article 14 are referred to in this report as "originally filed" and are not annexed to this report since they do not contain amendments (Rules 70.16 and 70.17)*):

Description, pages:

1-7	as received on	15/03/2001 with letter of	05/03/2001
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Claims, No.:

1-7	as received on	15/03/2001 with letter of	05/03/2001
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Drawings, sheets:

1,2	as received on	15/03/2001 with letter of	05/03/2001
-----	----------------	---------------------------	------------

2. With regard to the **language**, all the elements marked above were available or furnished to this Authority in the language in which the international application was filed, unless otherwise indicated under this item.

These elements were available or furnished to this Authority in the following language: , which is:

- the language of a translation furnished for the purposes of the international search (under Rule 23.1(b)).
- the language of publication of the international application (under Rule 48.3(b)).
- the language of a translation furnished for the purposes of international preliminary examination (under Rule 55.2 and/or 55.3).

3. With regard to any **nucleotide and/or amino acid sequence** disclosed in the international application, the international preliminary examination was carried out on the basis of the sequence listing:

- contained in the international application in written form.
- filed together with the international application in computer readable form.
- furnished subsequently to this Authority in written form.
- furnished subsequently to this Authority in computer readable form.
- The statement that the subsequently furnished written sequence listing does not go beyond the disclosure in the international application as filed has been furnished.
- The statement that the information recorded in computer readable form is identical to the written sequence listing has been furnished.

4. The amendments have resulted in the cancellation of:

- the description, pages:
- the claims, Nos.: 8

INTERNATIONAL PRELIMINARY  
EXAMINATION REPORT

International application No. PCT/ES99/00382

the drawings, sheets:

5.  This report has been established as if (some of) the amendments had not been made, since they have been considered to go beyond the disclosure as filed (Rule 70.2(c)):

*(Any replacement sheet containing such amendments must be referred to under item 1 and annexed to this report.)*  
**see separate sheet**

6. Additional observations, if necessary:

**V. Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability;  
citations and explanations supporting such statement**

**1. Statement**

Novelty (N) Yes: Claims 1-7  
No: Claims

Inventive step (IS) Yes: Claims 1-7  
No: Claims

Industrial applicability (IA) Yes: Claims 1-7  
No: Claims

**2. Citations and explanations  
see separate sheet**

**VII. Certain defects in the international application**

The following defects in the form or contents of the international application have been noted:  
**see separate sheet**

**VIII. Certain observations on the international application**

The following observations on the clarity of the claims, description, and drawings or on the question whether the claims are fully supported by the description, are made:  
**see separate sheet**

## INTERNATIONAL PRELIMINARY EXAMINATION REPORT

(PCT Article 36 and Rule 70) S

Applicant's or agent's file reference 199.221/MAD	<b>FOR FURTHER ACTION</b>		See Notification of Transmittal of International Preliminary Examination Report (Form PCT/PEA/416)
International application No. PCT/ES99/00382	International filing date (day/month/year) 25/11/1999	Priority date (day/month/year) 18/01/1999	
International Patent Classification (IPC) or national classification and IPC H01F27/06			
Applicant SOCIEDAD ESPANOLA DE ELECTROMEDICINA Y CALIDAD, SA			

1. This international preliminary examination report has been prepared by this International Preliminary Examining Authority and is transmitted to the applicant according to Article 36.
2. This REPORT consists of a total of 7 sheets, including this cover sheet.

This report is also accompanied by ANNEXES, i.e. sheets of the description, claims and/or drawings which have been amended and are the basis for this report and/or sheets containing rectifications made before this Authority (see Rule 70.16 and Section 607 of the Administrative Instructions under the PCT).

These annexes consist of a total of 11 sheets.

3. This report contains indications relating to the following items:

- I  Basis of the report
- II  Priority
- III  Non-establishment of opinion with regard to novelty, inventive step and industrial applicability
- IV  Lack of unity of invention
- V  Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement
- VI  Certain documents cited
- VII  Certain defects in the international application
- VIII  Certain observations on the international application

Date of submission of the demand 07/08/2000	Date of completion of this report 26.04.2001
Name and mailing address of the international preliminary examining authority: European Patent Office D-80298 Munich Tel. +49 89 2399 - 0 Tx: 523656 epmu d Fax: +49 89 2399 - 4465	Authorized officer Meul, H Telephone No. +49 89 2399 2494



INTERNATIONAL PRELIMINARY  
EXAMINATION REPORT

International application No. PCT/ES99/00382

**I. Basis of the report**

1. With regard to the elements of the international application (*Replacement sheets which have been furnished to the receiving Office in response to an invitation under Article 14 are referred to in this report as "originally filed" and are not annexed to this report since they do not contain amendments (Rules 70.16 and 70.17)*):

**Description, pages:**

1-7	as received on	15/03/2001 with letter of	05/03/2001
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**Claims, No.:**

1-7	as received on	15/03/2001 with letter of	05/03/2001
-----	----------------	---------------------------	------------

**Drawings, sheets:**

1,2	as received on	15/03/2001 with letter of	05/03/2001
-----	----------------	---------------------------	------------

2. With regard to the **language**, all the elements marked above were available or furnished to this Authority in the language in which the international application was filed, unless otherwise indicated under this item.

These elements were available or furnished to this Authority in the following language: , which is:

- the language of a translation furnished for the purposes of the international search (under Rule 23.1(b)).
- the language of publication of the international application (under Rule 48.3(b)).
- the language of a translation furnished for the purposes of international preliminary examination (under Rule 55.2 and/or 55.3).

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- contained in the international application in written form.
- filed together with the international application in computer readable form.
- furnished subsequently to this Authority in written form.
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- the description,      pages:
- the claims,      Nos.:      8

INTERNATIONAL PRELIMINARY  
EXAMINATION REPORT

International application No. PCT/ES99/00382

the drawings,      sheets:

5.  This report has been established as if (some of) the amendments had not been made, since they have been considered to go beyond the disclosure as filed (Rule 70.2(c)):

*(Any replacement sheet containing such amendments must be referred to under item 1 and annexed to this report.)*  
**see separate sheet**

6. Additional observations, if necessary:

**V. Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement**

1. Statement

Novelty (N)      Yes: Claims 1-7

No: Claims

Inventive step (IS)      Yes: Claims 1-7

No: Claims

Industrial applicability (IA)      Yes: Claims 1-7

No: Claims

2. Citations and explanations

**see separate sheet**

**VII. Certain defects in the international application**

The following defects in the form or contents of the international application have been noted:

**see separate sheet**

**VIII. Certain observations on the international application**

The following observations on the clarity of the claims, description, and drawings or on the question whether the claims are fully supported by the description, are made:

**see separate sheet**

**INTERNATIONAL PRELIMINARY  
EXAMINATION REPORT - SEPARATE SHEET**

International application No. PCT/ES99/00382

**Re Item I.5**

**Basis of the report: Unallowed amendments**

The amendments filed with the letter dated 05-03-01 introduce subject-matter which extends beyond the content of the application as filed, contrary to Article 34 (2) (b) PCT. The reasons are the following:

No clear basis in the claims, description and drawings as originally filed can be found for the term 'a resistive divider' used in amended claim 1 as well as on amended page 6, lines 5 and 9. The original description only mentions 'tension (voltage) dividers' (see p. 1, l. 15) or 'capacitative dividers' (see p. 5, l. 2 and l. 6).

**Re Item V**

**Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement**

Technical field:

The invention relates to a high voltage transformer.

Closest prior art:

The document US 4,587,606 A (=D1) discloses a high voltage transformer comprising secondary winding elements arranged in two groups having positive and negative voltages, respectively, around a primary winding of the air-core type. Rectifying diode groups are disposed on substrates which surround the secondary winding elements. The primary winding is connected to a DC source by means of a switching element.

Problem:

It is necessary to keep a minimum electrical insulation distance between the points of high voltage so that the insulation distance between points of minor voltage and, consequently, the total volume occupied by the transformer elements become excessive (see p. 1, l. 11 to p. 2, l. 9 of the present description).

INTERNATIONAL PRELIMINARY  
EXAMINATION REPORT - SEPARATE SHEET

International application No. PCT/ES99/00382

Solution:

Insofar as the present text of the claims can be understood (see section VIII of this report), the positive voltage components of at least the high voltage transformer with its magnetic core, the rectifier, the filter, the voltage divider, and the high voltage switch are arranged in one group and separated by solid insulating means from the negative voltage components of said transformer elements arranged in another group, with one end of all components being connected to ground level and the voltage in each component progressively increasing towards the opposed end in positive voltage components and progressively decreasing in the negative voltage components in such a manner that, at an equal distance from the ground level, the components of each group have equipotential voltages (see claim 1). Achievement of equipotential levels permits the components occupying the same level of potential to be brought close to each other.

Assessment:

None of the prior art documents cited in the International Search Report discloses or fairly suggests the present arrangement of positive and negative voltage components of transformer elements. More specifically, D1 is silent about any electrical insulation between positive and negative voltage components.

US 5,576,681 A discloses a high voltage transformer comprising a secondary winding which is divided into a plurality of partial windings arranged in cells of a compartmentalized coil form and connected to one another by diodes. The partial windings are positioned and dimensioned with respect to the primary winding to cause equal pulse voltages of like polarity to exist at the neighbouring portions of the primary winding and the partial windings in the vicinity of the gap between them. The various transformer elements are not separated into groups with either positive or negative voltages.

GB 2 045 012 A describes a high voltage power supply comprising a plurality of linked modular sub-assemblies each comprising a transformer secondary winding connected to a rectifier assembly to provide a DC output at a pair of output terminals. There is no common ground to which the first ends of all elements are connected and there is no insulating means separating positive voltage components from negative voltage components.

JP 06-333754 A discloses a transformer for cycloconverter having equal factors of resistance and leakage reactance in positive and negative group windings. Again, there is no common ground to which the first ends of all elements are connected and there is

no insulating means separating positive voltage components from negative voltage components.

The subject-matter of claim 1 is therefore novel and involves an inventive step with respect to the presently available prior art documents.

The dependent claims 2-7 define advantageous developments of the transformer assembly according to claim 1 and thus meet the requirements of novelty and inventive step as well.

**Re Item VII**

**Certain defects in the international application**

1. The description is not in conformity with the claims as required by Rule 5.1(a) (iii) PCT (see p. 3, l. 14-20).

**Re Item VIII**

**Certain observations on the international application**

1. A lack of clarity arises in the present claims because they are directed to a high voltage transformer comprising a high tension transformer. The difference between the terms 'high voltage transformer' and 'high tension transformer' is not clear. The claims should have been directed to a high voltage transformer assembly comprising a high voltage transformer.
2. Furthermore, it is not clear in claim 1 which of the plurality of 'conventional elements' for voltage transformers actually have a first end and a second end opposite to the first end, with the first end being connected to ground level. It appears that at least the magnetic core, the low voltage input and the housing are no such elements.

**INTERNATIONAL PRELIMINARY  
EXAMINATION REPORT - SEPARATE SHEET**

International application No. PCT/ES99/00382

3. It is not clear in claim 1 whether or not each 'conventional element' is divided into two sub-elements, one having positive voltage and the other one having negative voltage.

- 1 -

## **TRANSFORMADOR DE ALTA TENSION**

### **OBJETO DE LA INVENCION**

La invención que nos ocupa consiste en un transformador de alta tensión que tiene por objeto reducir considerablemente su tamaño y precio.

Evidentemente, la invención es utilizable en todas aquellas aplicaciones en las que se requiera proporcionar una alimentación de alto kilovoltaje, tanto en corriente continua, como en corriente alterna a alta o baja frecuencia.

### **ANTECEDENTES DE LA INVENCION**

Convencionalmente es sobradamente conocido el uso de transformadores de alto kilovoltaje cuyo diseño presenta la máxima dificultad en conseguir el aislamiento eléctrico necesario entre los distintos elementos que lo componen (transformadores, conectores de alta tensión, rectificadores, filtros, divisores de tensión, descargadores, etc.). El aislamiento se realiza convencionalmente de tres formas diferentes:

1.- Llenado al vacío y en ambiente seco, todo el interior de tanque o carcasa que contiene los distintos elementos del transformador, con un fluido líquido o gaseoso, que normalmente es aceite de silicona o aceite mineral, debido a la fácil manipulación y bajo coste que tienen.

2.- Utilizando piezas aislantes sólidas, como pueden ser plásticos, vidrios, porcelanas, resinas, etc.

3.- Encapsulando todo el conjunto al vacío con resinas o siliconas aislantes de alta tensión.

En cualquiera de estas tres formas de realizar el aislamiento, es necesario mantener unas distancias mínimas entre los distintos elementos que componen el transformador. Esta distancia mínima depende de la tensión aplicada entre los distintos elementos, de forma que es necesario mantener la distancia mínima de aislamiento entre

- 2 -

los puntos de mayor tensión, lo que implica que en la mayoría de los casos, la distancia de aislamiento resulta excesiva para conseguir el aislamiento entre los puntos de menor tensión. La consecuencia final es que los elementos 5 ocupan un volumen muy elevado, y además este volumen hay que cubrirlo con el material aislante, lo cual aumenta considerablemente el peso y sobre todo el costo del transformador.

Además, este diseño para conseguir las 10 distancias mínimas, dificulta el montaje de los distintos elementos del transformador, lo que igualmente encarece su coste.

#### DESCRIPCION DE LA INVENCION

Para resolver todos los inconvenientes 15 anteriormente indicados, la invención ha desarrollado un nuevo transformador de alta tensión, que se caracteriza porque los elementos convencionales que lo constituyen se disponen en dos grupos diferenciados, por una parte los 20 elementos con tensiones positivas y por otra los elementos con tensiones negativas, quedando ambos grupos separados por medios aislantes.

Además la disposición de los elementos prevé que ventajosamente éstos se diseñan de forma que uno de los extremos de todos ellos tienen nivel de tierra o "tensión 25 0". Esta tensión aumenta progresivamente hacia el extremo opuesto en los elementos con tensiones positivas, y disminuye progresivamente en los elementos con tensiones negativas; todo ello de forma que, a un mismo nivel o distancia desde el nivel de tierra, los elementos de cada 30 grupo tienen tensiones equipotenciales.

Esta estructura tiene la gran ventaja de que los elementos de un mismo grupo no necesitan aislamiento entre ellos, por lo que la distancia que los debe de separar se reduce considerablemente, y además los elementos 35 que ocupan la misma zona de potencial no influyen para nada

- 3 -

en la capacidad parásita, por lo tanto no hay limitaciones ni en su proximidad ni en la superficie enfrentada entre ellos.

Por consiguiente, mediante la invención, al 5 diseñarse los elementos de forma que sus niveles de tensión están de acuerdo a la zona de potencial que ocupa, permite aproximar los elementos entre sí hasta casi entrar en contacto, de modo que se reduce considerablemente el volumen, y por tanto se reduce considerablemente el 10 aislante que rellena el interior de la carcasa o tanque del transformador.

Como consecuencia de esta reducción de volumen, se consigue una considerable reducción del peso al 15 ser el tanque de menores dimensiones y necesitarse una menor cantidad de aislante de relleno.

Otra de las ventajas que presenta la invención es la reducción de las capacidades parásitas, lo que disminuye algunos efectos secundarios indeseables.

El aumento progresivo de la tensión en los 20 elementos con tensión positiva y la disminución progresiva de la tensión en los elementos con tensión negativa, es lineal.

Ventajosamente el nivel de tierra o "tensión 0" se ubica en correspondencia con las señales de entrada 25 de baja tensión.

En una realización preferente, el nivel de "tensión 0" se ubica en la cara superior del transformador, de forma que el máximo nivel de potencia está definido en el extremo inferior de los conectores de alta tensión.

Los medios aislantes que separan los dos 30 grupos de elementos, están determinados por una única barrera aislante, lo que simplifica considerablemente el montaje de los distintos elementos del transformador, al mismo tiempo que reduce su coste.

Otra característica de la invención reside en 35

- 4 -

el hecho de que cuenta con medios para minimizar las capacidades parásitas entre los elementos de un grupo y los del otro. Estos medios están determinados por la disposición que presentan los diferentes elementos de un grupo y 5 otro, de forma que se ubican de forma que sea mínima la superficie enfrentada de los elementos de un grupo con la superficie enfrentada de los elementos del otro grupo.

Mediante la invención también se reduce el número de piezas de soporte y aislamiento eléctrico así 10 como la mano de obra para efectuar el montaje.

Como consecuencia de todo lo expuesto es evidente que la invención reduce considerablemente el coste total del tanque, así como su almacenamiento y transporte.

15 A continuación para facilitar una mejor comprensión de esta memoria descriptiva y formando parte integrante de la misma, se acompañan una serie de figuras en las que con carácter ilustrativo y no limitativo se ha representado el objeto de la invención.

#### BREVE ENUNCIADO DE LAS FIGURAS

20 **Figura 1.**— Muestra una vista esquemática en planta de un posible ejemplo de realización del transformador de la invención. En esta figura se ha eliminado la cara superior o tapa de la carcasa o tanque del transformador.

25 **Figura 2.**— Muestra una vista lateral del transformador de la figura anterior, en el que se ha seccionado la cara lateral para apreciar claramente la disposición de los diferentes elementos.

**Figura 3.**— Muestra una vista según la sección A-B de la figura anterior.

#### 30 DESCRIPCION DE LA FORMA DE REALIZACION PREFERIDA DE LA INVENCION

A continuación se realiza una descripción de la invención basada en las figuras anteriormente comentadas.

35 El transformador de la invención presenta como

- 5 -

carácterística el hecho de que los elementos convencionales que lo constituyen se disponen en dos grupos diferenciados, de forma que por un lado se sitúan los elementos con tensiones positivas, y por otro los elementos con tensiones negativas.

5 negativas.  
Para ello en una mitad longitudinal del transformador se dispone: un transformador de alta tensión 1, con su núcleo magnénitco 7 un rectificador 2, un filtro 3, un divisor resistivo 4 y un conector de ánodo 5, que  
10 constituyen los elementos que soportan tensiones positivas.

En la otra mitad longitudinal se dispone un transformador de alta tensión 1' con su núcleo magnético 7', un rectificador 2', un filtro 3', un divisor resistivo 4' y el conector de cátodo 5', que constituyen los elementos que soportan tensiones negativas.

Entre ambos grupos se dispone una barrera aislante 6 que proporciona el correcto aislamiento entre los dos grupos, en tanto que el aislamiento entre los diferentes elementos de cada grupo, se consigue mediante la fijación de un nivel de tierra o "tensión 0" en la cara superior que se aumenta progresivamente hacia el extremo inferior en los elementos con tensiones positivas, y disminuye progresivamente en los elementos con tensiones negativas; de forma que a un mismo nivel o distancia desde el nivel de tierra, los elementos de cada grupo tienen tensiones iguales, tal y como se ha representado en las figuras 2 y 3, en las que se han marcado los niveles de tensión de  $0 \pm 20\text{Kv}$ ,  $\pm 40\text{Kv}$ ,  $\pm 80\text{Kv}$ .

30 De esta forma desde el nivel de 0 voltios hacia abajo, se va incrementando linealmente el potencial, quedando el máximo nivel de potencia definido por el extremo inferior de los conectores 5 y 5'.

La obtención de los niveles equipotenciales, permite que los elementos que ocupan la misma zona de potencial, se pueden aproximar entre ellos hasta casi

- 6 -

entrar en contacto, ya que no necesitan aislantes y no influyen para nada en la capacidad parásita, y por lo tanto no hay limitaciones ni en su proximidad ni en la superficie enfrentada entre los mismos, de forma que se reduce considerablemente el volumen total del transformador.

Además, tal y como se aprecia en la figura 1, la superficie enfrentada de los elementos de un grupo con la superficie enfrentada de los elementos de otro grupo, es mínima, de forma que se minimizan las capacidades parásitas.

Todos los elementos descritos quedan incluidos en la carcasa 8 que es obturada superiormente por la tapa 9 que constituye el punto de tensión 0, en la cual se dispone la entrada 10 de baja tensión, que evidentemente comparada con la alta tensión que se va generando en los distintos niveles, es una tensión despreciable, y por tanto puede considerarse nivel de tensión 0.

Tal y como ya fue descrito en el apartado de antecedentes de la invención, el interior del tanque o carcasa 8, se rellena con un material aislante, que en el ejemplo de realización es un aceite de silicona o aceite mineral, y a modo de ejemplo cabe señalar que la cantidad de este aislante requerida para llenar la totalidad del volumen, es de 4 litros, que en comparación con los 36 litros que requieren los transformadores convencionales, representa una reducción de volumen muy elevada, con el consiguiente ahorro que ello representa.

Evidentemente, el aislante empleado, tal y como se señalaba en el apartado de antecedentes de la invención, puede materializarse mediante el encapsulado de todo el conjunto al vacío, con resinas o siliconas aislantes de alta tensión.

- 7 -

#### **REIVINDICACIONES**

1.- **TRANSFORMADOR DE ALTA TENSION**, que se caracteriza porque los elementos convencionales que lo constituyen, se disponen en dos grupos diferenciados; por 5 una parte los elementos con tensiones positivas (1-5 y 7) y por otra los elementos con tensiones negativas (1'-5' y 7'), estando ambos separados por medios aislantes; y habiéndose previsto que uno de los extremos de todos los elementos tienen nivel de tierra o "tensión 0", y ésta 10 aumenta progresivamente hacia el extremo opuesto en los elementos con tensiones positivas, y disminuye progresivamente en los elementos con tensiones negativas; todo ello de forma que, a un mismo nivel o distancia desde el nivel de tierra, los elementos de cada grupo tienen tensiones 15 equipotenciales.

2.-**TRANSFORMADOR DE ALTA TENSION**, según reivindicación 1, caracterizado porque el aumento progresivo de la tensión en los elementos con tensión positiva y la disminución progresiva de la tensión en los elementos con tensión negativa, es lineal.

3.- **TRANSFORMADOR DE ALTA TENSION**, según reivindicación 1, caracterizado porque el nivel de "tensión 0" se ubica en correspondencia con las señales de entrada de baja tensión (10).

4.- **TRANSFORMADOR DE ALTA TENSION**, según reivindicación 3, caracterizado porque el nivel de "tensión 0" se ubica en la cara superior (9) del transformador.

5.- **TRANSFORMADOR DE ALTA TENSION**, según cualquiera de las reivindicaciones anteriores, caracterizado porque el máximo nivel de potencial está definido en el extremo inferior de los conectores de alta tensión (5, 5').

6.- **TRANSFORMADOR DE ALTA TENSION**, según reivindicación 1, caracterizado porque los dos grupos se 35 separan por una única barrera aislante (6).

- 8 -

7.- **TRANSFORMADOR DE ALTA TENSION**, según reivindicación 1, caracterizado porque cuenta con medios para minimizar las capacidades parásitas entre los elementos de un grupo y los del otro.

5                   8.- **TRANSFORMADOR DE ALTA TENSION**, según reivindicación 7, caracterizado porque los medios para minimizar las capacidades parásitas entre los elementos de un grupo y los de otro, están determinados por una disposición de dichos elementos, de manera que los elementos de un grupo tengan una mínima superficie enfrentada a los  
10                 elementos del otro grupo.

1/2

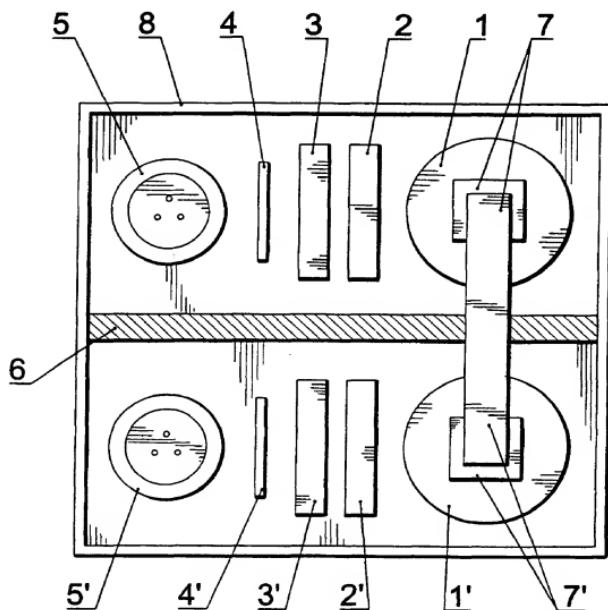


FIG. 1

2/2

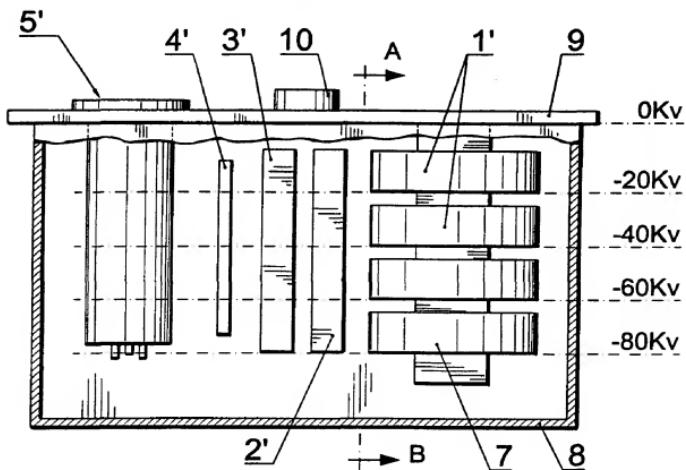


FIG. 2

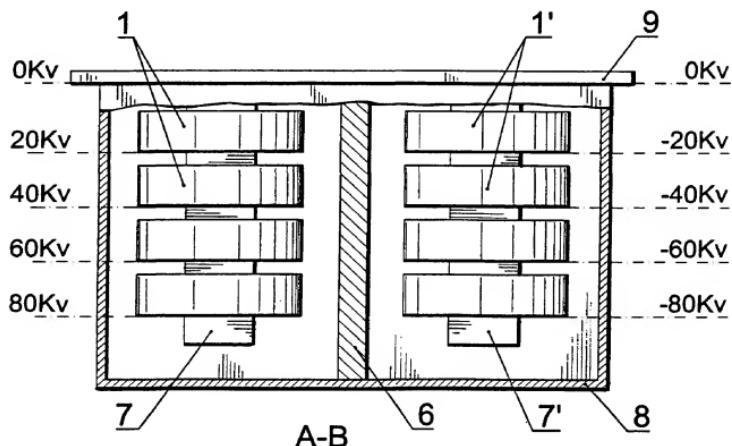


FIG. 3

## INTERNATIONAL SEARCH REPORT

International application No.  
PCT/ES 99/00382

## A. CLASSIFICATION OF SUBJECT MATTER

IPC7 : H01F 27/06, H01F 27/34

According to International Patent Classification (IPC) or to both national classification and IPC

## B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC7: H01F, H02M, H02B

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)  
EPODOC, WPI, PAJ, MISTRAL

## C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 4 587 606 A (SANADA) 06 May 1986 (06.05.86) column 3, line 34 – column 4, line 54 ; figures 1 et 3	1
Y	US 5 576 681 A (SANDER ET AL) 19 November 1996 (19.11.96) figures 1 and 2, column 2 lines 14-31	1,3
Y	GB 2 045 012 A (WESTINGHOUSE BRAKE & SIGNAL CO. LTD) 22 October 1980, page 2, lines 74-77 ; figure 3	1,3
Y	Data base WPI in EPOQUE, week 9508, London :Derwent Publications Ltd., AN 95-055467, Classification X12, & JP 6333754 A (TOSHIBA CORP) 02 December 1994 (12.12.94) abstract ; figure 3	1,2

Further documents are listed in the continuation of box C.

Patent family members are listed in annex.

## \* Special categories of cited documents:

- "A" document defining the general state of the art which is not considered to be of particular relevance
- "E" earlier document but published on or after the international filing date
- "L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)
- "O" document referring to an oral disclosure, use, exhibition or other means
- "P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&" document member of the same patent family

Date of the actual completion of the international search report

23 February 2000 (23.02.00)

Date of mailing of the international search report

6 March 2000 (06.03.00)

Name and mailing address of the ISA

S.P.T.O

Authorized officer

Telephone No.

## INTERNATIONAL SEARCH REPORT

Information on patent family members

International Application No

PCT/ES99/00382

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 4587606	06.05.1986	JP 1813875 C JP 5014408 B JP 60081813 A EP 0147544 AB	18.01.1994 25.02.1993 09.05.1985 10.07.1985
US 5576681	19.11.1996	HK 1000744 A SG 46549 A ES 2097823 T JP 6503448 T HU 64660 A PT 99742 AB EP 0561839 AB TR 25836 A FI 932627 A WO 9210906 A DE 4039373 A CA 2098100 A MX 9102455 A	24.04.1998 20.02.1998 16.04.1997 14.04.1994 28.01.1994 30.11.1993 29.09.1993 01.09.1993 09.06.1993 25.06.1992 11.06.1992 10.06.1992 01.06.1992
GB 2045012	22.10.1980	NONE	NONE
JP 6333754	02.12.1994	NONE	NONE

## INFORME DE BÚSQUEDA INTERNACIONAL

Solicitud internacional nº  
PCT/ES99/00382

## A. CLASIFICACIÓN DEL OBJETO DE LA SOLICITUD

CIP<sup>7</sup> H01F 27/06, H01F 27/34

De acuerdo con la Clasificación Internacional de Patentes (CIP) o según la clasificación nacional y la CIP.

## B. SECTORES COMPRENDIDOS POR LA BÚSQUEDA

Documentación mínima consultada (sistema de clasificación, seguido de los símbolos de clasificación)

CIP<sup>7</sup> H01F, H02M, H02B

Otra documentación consultada, además de la documentación mínima, en la medida en que tales documentos formen parte de los sectores comprendidos por la búsqueda

Bases de datos electrónicas consultadas durante la búsqueda internacional (nombre de la base de datos y, si es posible, términos de búsqueda utilizados)

EPODOC, WPI, PAJ, MISTRAL

## C. DOCUMENTOS CONSIDERADOS RELEVANTES

Categoría*	Documentos citados, con indicación, si procede, de las partes relevantes	Relevante para las reivindicaciones nº
X	US 4 587 606 A (SANADA) 06.05.1986, columna 3, línea 34 - columna 4, línea 54; figuras 1 y 3	1
Y		2,3
Y	US 5 576 681 A (SANDER ET AL) 19.11.1996, figuras 1 y 2; columna 2, líneas 14 -31	1-3
Y	GB 2 045 012 A (WESTINGHOUSE BRAKE & SIGNAL CO. LTD) 22.10.1980, página 2, líneas 74-77; figura 3	1,2
Y	Base de datos WPI en EPOQUE, semana 9508, Londres:Derwent Publications Ltd., AN 95-055467, Clase X12, & JP 6333754 A (TOSHIBA CORP) 02.12.1994, resumen; figura 3	1,2

 En la continuación del recuadro C se relacionan otros documentos Los documentos de familia de patentes se indican en el anexo

## \* Categorías especiales de documentos citados:

"A" documento que define el estado general de la técnica no considerado como particularmente relevante.

"T" documento anterior publicado con posterioridad a la fecha de presentación internacional o de prioridad que no pertenece al estado de la técnica pertinente pero que se cita por permitir la comprensión del principio o teoría que constituye la base de la invención.

"E" solicitud de patente o patente anterior pero publicada en la fecha de presentación internacional o en fecha posterior.

"X" documento particularmente relevante; la invención reivindicada no puede considerarse nueva o que implique una actividad inventiva por referencia al documento aisladamente considerado.

"L" documento que puede plantear dudas sobre una reivindicación de prioridad o que se cita para determinar la fecha de publicación de otra cita o por una razón especial (como la indicada).

"Y" documento particularmente relevante; la invención reivindicada no puede considerarse que implique una actividad inventiva cuando el documento se asocia a otro u otros documentos de la misma naturaleza, cuya combinación resulta evidente para un experto en la materia.

"O" documento que se refiere a una divulgación oral, a una utilización, a una exposición o a cualquier otro medio.

"D" documento que forma parte de la misma familia de patentes.

"P" documento publicado antes de la fecha de presentación internacional pero con posterioridad a la fecha de prioridad reivindicada.

Fecha en que se ha concluido efectivamente la búsqueda internacional.

23.02.2000

Fecha de expedición del informe de búsqueda internacional

6 MAR 2000 6.03.00

Nombre y dirección postal de la Administración encargada de la búsqueda internacional O.E.P.M.  
C/ Panamá 1, 28071 Madrid, España.  
nº de fax +34 91 349 53 04

Funcionario autorizado:

Maria Paz Pérez Moreno  
+34 91 349 53 94

**INFORME DE BÚSQUEDA INTERNACIONAL**  
Información relativa a miembros de familias de patentes

solicitud internacional nº

PCT/ES99/00382

Documento de patente citado en el informe de búsqueda	Fecha de publicación	Miembro(s) de la familia de patentes	Fecha de publicación
US 4587606	06.05.1986	JP 1813875 C JP 5014408 B JP 60081813 A EP 0147544 AB	18.01.1994 25.02.1993 09.05.1985 10.07.1985
US 5576681	19.11.1996	HK 1000744 A SG 46549 A ES 2097823 T JP 6503448 T HU 64660 A PT 99742 AB EP 0561839 AB TR 25836 A FI 932627 A WO 9210906 A DE 4039373 A CA 2098100 A MX 9102455 A	24.04.1998 20.02.1998 16.04.1997 14.04.1994 28.01.1994 30.11.1993 29.09.1993 01.09.1993 09.06.1993 25.06.1992 11.06.1992 10.06.1992 01.06.1992
GB 2045012	22.10.1980	NO HAY	NO HAY
JP 6333754	02.12.1994	NO HAY	NO HAY

## INFORME DE BÚSQUEDA INTERNACIONAL

Solicitud internacional nº  
PCT/ES99/003

## A. CLASIFICACIÓN DEL OBJETO DE LA SOLICITUD

CIP<sup>7</sup> H01F 27/06, H01F 27/34

De acuerdo con la Clasificación Internacional de Patentes (CIP) o según la clasificación nacional y la CIP.

## B. SECTORES COMPRENDIDOS POR LA BÚSQUEDA

Documentación mínima consultada (sistema de clasificación, seguido de los símbolos de clasificación)

CIP<sup>7</sup> H01F, H02M, H02B

Otra documentación consultada, además de la documentación mínima, en la medida en que tales documentos formen parte de los sectores comprendidos por la búsqueda

Bases de datos electrónicas consultadas durante la búsqueda internacional (nombre de la base de datos y, si es posible, términos de búsqueda utilizados)

EPODOC, WPI, PAJ, MISTRAL

## C. DOCUMENTOS CONSIDERADOS RELEVANTES

Categoría*	Documentos citados, con indicación, si procede, de las partes relevantes	Relevante para las reivindicaciones nº
X	US 4 587 606 A (SANADA) 06.05.1986, columna 3, línea 34 - columna 4, línea 54; figuras 1 y 3	1
Y		2,3
Y	US 5 576 681 A (SANDER ET AL) 19.11.1996, figuras 1 y 2; columna 2, líneas 14 -31	1-3
Y	GB 2 045 012 A (WESTINGHOUSE BRAKE & SIGNAL CO. LTD) 22.10.1980, página 2, líneas 74-77; figura 3	1,2
Y	Base de datos WPI en EPOQUE, semana 9508, Londres:Derwent Publications Ltd., AN 95-055467, Clase X12, & JP 6333754 A (TOSHIBA CORP) 02.12.1994, resumen; figura 3	1,2

 En la continuación del recuadro C se relacionan otros documentos Los documentos de familia de patentes se indican en el anexo

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"A" documento que define el estado general de la técnica no considerado como particularmente relevante.

"E" solicitud de patente o patente anterior pero publicada en la fecha de presentación internacional o en fecha posterior.

"L" documento que puede plantear dudas sobre una reivindicación de prioridad o que se cita para determinar la fecha de publicación de otra cita o por una razón especial (como la indicada).

"O" documento que se refiere a una divulgación oral, a una utilización, a una exposición o a cualquier otro medio.

"P" documento publicado antes de la fecha de presentación internacional pero con posterioridad a la fecha de prioridad reivindicada.

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"X" documento particularmente relevante; la invención reivindicada no puede considerarse nueva o que implica una actividad inventiva por referencia al documento anteriormente considerado.

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"\*&amp;" documento que forma parte de la misma familia de patentes.

Fecha en que se ha concluido efectivamente la búsqueda internacional. 23.02.2000

Fecha de expedición del informe de búsqueda internacional

56 MAR 2000 56.03.00

Nombre y dirección postal de la Administración encargada de la búsqueda internacional O.E.P.M C/Panamá 1, 28071 Madrid, España. n.º de fax +34 91 349 53 04

Funcionario autorizado:

Maria Paz Pérez Moreno  
+34 91 349 53 94

**INFORME DE BÚSQUEDA INTERNACIONAL**  
Información relativa a miembros de familias de patentes

Solicitud internacional nº

PCT/ES99/00382

Documento de patente citado en el informe de búsqueda	Fecha de publicación	Miembro(s) de la familia de patentes	Fecha de publicación
US 4587606	06.05.1986	JP 1813875 C JP 5014408 B JP 60081813 A EP 0147544 AB	18.01.1994 25.02.1993 09.05.1985 10.07.1985
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GB 2045012	22.10.1980	NO HAY	NO HAY
JP 6333754	02.12.1994	NO HAY	NO HAY

## INTERNATIONAL SEARCH REPORT

International application No.  
PCT/ES 99/00382

## A. CLASSIFICATION OF SUBJECT MATTER

IPC7 : H01F 27/06, H01F 27/34

According to International Patent Classification (IPC) or to both national classification and IPC

## B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)  
IPC7: H01F, H02M, H02B

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)  
EPODOC, WPI, PAJ, MISTRAL

## C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
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Y	US 5 576 681 A (SANDER ET AL) 19 November 1996 (19.11.96) figures 1 and 2 , column 2 lines 14-31	1,3
Y	GB 2 045 012 A (WESTINGHOUSE BRAKE & SIGNAL CO. LTD) 22 October 1980, page 2, lines 74-77 ; figure 3	1,3
Y	Data base WPI in EPOQUE, week 9508, London :Derwent Publications Ltd., AN 95-055467, Classification X12, & JP 6333754 A (TOSHIBA CORP) 02 December 1994 (12.12.94) abstract ; figure 3	1,2

 Further documents are listed in the continuation of box C. Patent family members are listed in annex.

\* Special categories of cited documents:

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier document but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&amp;" document member of the same patent family

Date of the actual completion of the international search report

Date of mailing of the international search report

23 February 2000 (23.02.00)

6 March 2000 (06.03.00)

Name and mailing address of the ISA

Authorized officer

Telephone No.

S.P.T.O

INTERNATIONAL SEARCH REPORT  
Information on patent family members

International Application No

PCT/ES99/00382

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 4587606	06.05.1986	JP 1813875 C JP 5014408 B JP 60081813 A EP 0147544 AB	18.01.1994 25.02.1993 09.05.1985 10.07.1985
US 5576681	19.11.1996	HK 1000744 A SG 46549 A ES 2097823 T JP 6503448 T HU 64660 A PT 99742 AB EP 0561839 AB TR 25836 A FI 932627 A WO 9210906 A DE 4039373 A CA 2098100 A MX 9102455 A	24.04.1998 20.02.1998 16.04.1997 14.04.1994 28.01.1994 30.11.1993 29.09.1993 01.09.1993 09.06.1993 25.06.1992 11.06.1992 10.06.1992 01.06.1992
GB 2045012	22.10.1980	NONE	NONE
JP 6333754	02.12.1994	NONE	NONE

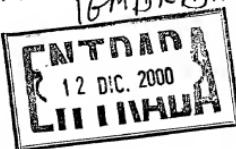
# PATENT COOPERATION TREATY

From the:  
INTERNATIONAL PRELIMINARY EXAMINING AUTHORITY

To:

UNGRIA LOPEZ, Javier  
Avenida Ramon y Cajal, 78  
E-28043 Madrid  
ESPAGNE

16M(DR/LD)7



PCT

WRITTEN OPINION

(PCT Rule 66)

Applicant's or agent's file reference 199.221/MAD		Date of mailing (day/month/year) 04.12.2000
International application No. PCT/ES99/00382	International filing date (day/month/year) 25/11/1999	REPLY DUE within 3 month(s) from the above date of mailing Priority date (day/month/year) 18/01/1999
International Patent Classification (IPC) or both national classification and IPC H01F27/06		
Applicant SOCIEDAD ESPANOLA DE ELECTROMEDICINA Y CALIDAD, SA		

1. This written opinion is the **first** drawn up by this International Preliminary Examining Authority.

2. This opinion contains indications relating to the following items:

- I  Basis of the opinion
- II  Priority
- III  Non-establishment of opinion with regard to novelty, inventive step and industrial applicability
- IV  Lack of unity of invention
- V  Reasoned statement under Rule 66.2(a)(ii) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement
- VI  Certain document cited
- VII  Certain defects in the international application
- VIII  Certain observations on the international application

3. The applicant is hereby **invited to reply** to this opinion.

**When?** See the time limit indicated above. The applicant may, before the expiration of that time limit, request this Authority to grant an extension, see Rule 66.2(d).

**How?** By submitting a written reply, accompanied, where appropriate, by amendments, according to Rule 66.3. For the form and the language of the amendments, see Rules 66.8 and 66.9.

**Also:** For an additional opportunity to submit amendments, see Rule 66.4. For the examiner's obligation to consider amendments and/or arguments, see Rule 66.4 bis. For an informal communication with the examiner, see Rule 66.6.

If no reply is filed, the international preliminary examination report will be established on the basis of this opinion.

4. The final date by which the international preliminary examination report must be established according to Rule 69.2 is: 18/05/2001.

Name and mailing address of the international preliminary examining authority:   European Patent Office D-80294 Munich Tel. +49 89 2399 - 0 Tx: 523656 epmu d Fax: +49 89 2399 - 4465	Authorized officer / Examiner  Meul, H
Formality officer (incl. extension of time limits) Schuster-Kaechele, W Telephone No. +49 89 2399 2281	



## WRITTEN OPINION

International application No. PCT/ES99/00382

### I. Basis of the opinion

1. This opinion has been drawn on the basis of (*substitute sheets which have been furnished to the receiving Office in response to an invitation under Article 14 are referred to in this opinion as "originally filed"*).)

#### Description, pages:

1-6 as originally filed

#### Claims, No.:

1-8 as originally filed

#### Drawings, sheets:

1-2 as originally filed

2. With regard to the **language**, all the elements marked above were available or furnished to this Authority in the language in which the international application was filed, unless otherwise indicated under this item.

These elements were available or furnished to this Authority in the following language: , which is:

- the language of a translation furnished for the purposes of the international search (under Rule 23.1(b)).
- the language of publication of the international application (under Rule 48.3(b)).
- the language of a translation furnished for the purposes of international preliminary examination (under Rule 55.2 and/or 55.3).

3. With regard to any **nucleotide and/or amino acid sequence** disclosed in the international application, the international preliminary examination was carried out on the basis of the sequence listing:

- contained in the international application in written form.
- filed together with the international application in computer readable form.
- furnished subsequently to this Authority in written form.
- furnished subsequently to this Authority in computer readable form.
- The statement that the subsequently furnished written sequence listing does not go beyond the disclosure in the international application as filed has been furnished.
- The statement that the information recorded in computer readable form is identical to the written sequence listing has been furnished.

4. The amendments have resulted in the cancellation of:

- the description, pages:
- the claims, Nos.:

**WRITTEN OPINION**

International application No. PCT/ES99/00382

the drawings, sheets:

5.  This report has been established as if (some of) the amendments had not been made, since they have been considered to go beyond the disclosure as filed (Rule 70.2(c));

*(Any replacement sheet containing such amendments must be referred to under item 1 and annexed to this report.)*

6. Additional observations, if necessary:

**V. Reasoned statement under Rule 66.2(a)(ii) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement****1. Statement**

Novelty (N)	Claims 1,2,3
Inventive step (IS)	Claims
Industrial applicability (IA)	Claims

**2. Citations and explanations**

**see separate sheet**

**VII. Certain defects in the international application**

The following defects in the form or contents of the international application have been noted:  
**see separate sheet**

**VIII. Certain observations on the international application**

The following observations on the clarity of the claims, description, and drawings or on the question whether the claims are fully supported by the description, are made:

**see separate sheet**

**Re Item V**

**Reasoned statement under Rule 66.2 (a) (ii) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement**

1. Reference is made to the following documents:

A D1: US 4,587,606 A       B D2: US 5,576,681 A  
 C D3: GB 2 045 012 A       D D4: JP 6-333754 A

2. The present claims are not clear (see section VIII of this written opinion). Insofar as the wording of claim 1 can be understood, it is considered that the subject-matter of claim 1 is not novel (Article 33.2 PCT) for the following reasons:

The document D1 discloses a high voltage transformer (see Figs. 1, 2 and related text of D1) comprising 'conventional elements' such as windings and rectifiers which are arranged in two different groups (see Fig. 2), one group comprising the elements (6S1, ..., 6Sn; 8A1, ..., 8An+1; 8B1, ..., 8Bn+1) with positive voltages and the other group comprising the elements (6Sn+1, ..., 6S2n+2; 8An+2, ..., 8A2n+2; 8Bn+2, ..., 8B2n+2) with negative voltages. The two groups are separated from each other by insulating means, namely the insulation oil (see col. 1, l. 15-16 of D1). The elements are electrically connected in such a manner that 'one of the ends of all the elements' has ground level and that the elements of each group have equipotential voltages at equal distance from the ground level (see Fig. 2 and related text of D1). *Entfernen eines freien Endes einer Spule*

Therefore, present claim 1 reads upon the transformer disclosed in D1.

3. Dependent claims 2 and 3 do not contain any features which, in combination with the features of any claim to which they refer, meet the requirements of the PCT in respect of novelty and/or inventive step, the reasons being as follows:

Claim 2:

A linear increase/decrease of the voltages of the elements with each group can be

derived from the 'ladder structure' as disclosed in Figs. 2, 3 of D1).

Claim 3:

The level of zero voltage in the D1 transformer is located 'in correspondence' with the signals of the low voltage input (see Figs. 2, 3 of D1).

✗ 4. It is not at present apparent which part of the application could serve as a basis for a new independent claim that would meet the requirements of Articles 33.2 and 33.3 PCT. Should the applicant submit new claims which take account of the above comments, then he should also indicate in the letter of reply the difference of the subject-matter of the new claim vis-à-vis the state of the art as disclosed in the documents D1 to D4 and the significance thereof.

Y In order to facilitate the examination of the conformity of the amended application with the requirements of Article 34 (2) (b) PCT, the applicant is requested to clearly identify the amendments carried out, no matter whether they concern amendments by addition, replacement or deletion, and to indicate the passages of the application as filed on which these amendments are based (see also Rule 66.8(a) PCT).

✗ **Re Item VII**  
**Certain defects in the international application**

✗ 1. A document reflecting the prior art described on pages 1-2, is not identified in the description (Rule 5.1 (a) (ii) PCT). Moreover, the relevant background art disclosed in the documents D1 to D4 is not mentioned in the description, nor are these documents identified therein.

✗ 2. The text on page 4, lines 3-5 is incomplete. *traducción no correcta*  
Furthermore, on page 5, line 19 it should probably read 'in figures 2 and 3'.

Re Item VIII

**Certain observations on the international application**

The present version of claims does not meet the requirements of Article 6 PCT for the following reasons:

✓ 1. ~~1. 1~~ The term 'tension' used in the claims and throughout the whole description is unusual in the present technical field and should be replaced by the normal term 'voltage' (see e.g. col. 1, l. 7-29 of D1).  
    ~~1. 2~~ Furthermore, the wording 'and whereby it is foreseen that' used in claim 1 is not concise and should be replaced by 'and in that'.  
    ~~1. 3~~

✓ 2. ~~2. 1~~ A lack of clarity arises in claim 1 because 'the conventional elements' are not explicitly defined. It is therefore not clear which elements are actually meant.  
    ~~2. 2~~

✓ 3. ~~3. 1~~ A further lack of clarity arises in claim 1 due to the wording 'one of the ends of all the elements has ground level'. This wording does not clearly state that (i) each element has a first end and a second end opposite to the first end and that (ii) the first ends of all elements are connected to ground level.  
    ~~3. 2~~

✓ 4. ~~4. 1~~ A further lack of clarity arises in claim 1 due to the wording 'at and (?) equal level or distance from the ground level'. The first alternative 'at equal level' is vague and indefinite and may have the meaning of 'voltage level' or 'potential level' so that the entire statement 'the elements of each group have equipotential voltages at equal potential level' appears trivial. This feature should thus be restricted to the second alternative 'at equal distance' by deleting the expression 'level or'.  
    ~~4. 2~~

✓ 5. ~~5. 1~~ A lack of clarity arises in claim 3 because the wording 'the level of zero voltage is located in correspondence (?) with the signals of the low voltage input' is vague and indefinite. A further lack of clarity arises in claim 3 because there is no antecedent for 'the' low voltage input in the precedent claims.  
    ~~5. 2~~

✓ 6. ~~6. 1~~ Claim 5 is not clear because there is no antecedent for 'the' high voltage switches' in the precedent claims.

**WRITTEN OPINION  
SEPARATE SHEET**

International application No. PCT/ES99/00382

*and having now*

7. A lack of clarity arises in claim 6 because the term 'barrier' is vague and indefinite. Note that the prior art insulating oil filling represents an electric barrier.
8. Claim 7 lacks clarity because the claim to define the its features in terms of a result to be achieved without stating how this result, i.e. a minimized stray capacitance, can be achieved. The necessary elements are recited in claim 8.



09/889534  
JU/HA/IGM/yo  
JU/HA/IPT/PTO 1-8 JUL 2001

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CORRESPONSALES ESPECIALIZADOS  
EN TODOS LOS PAISES DEL MUNDO

JU/HA/IGM/yo

Madrid, 5 March 2001

Via fax: 00 49 89 2399 - 4465 Confirmation by registered mail

total number of pages, including this one: 4+13+9=26

Re.: International Patent Application No.: PCT/ES99/00382

Priority: Spanish Patent Application P9900089 of the  
18.01.1999

Applicants: SOCIEDAD ESPAÑOLA DE  
ELECTROMEDICINA...et al.

O/Ref.: 199.221/MAD

Dear Sirs:

(1) In response to the first Written Opinion issued on the above referenced application, the following is submitted on behalf of the applicants:

- \* replacement sheets 1-7 with a description
- \* replacement sheets 8-9 with a new set of claims 1-7
- \* explanatory sheets 1-9 which are copies of pages 1-9 of original English translation in which amendments to the description and claims have been inserted in handwriting, and additional sheets -2a, 2b and 7a- showing further amendments made in the description
- \* replacement sheets 1-2 of the drawings

(1.1) As readily apparent, the amended claims are supported in the original disclosure of this application as follows:

- Amended claim 1 is supported in original claim 1 and what is disclosed in the description.
- Amended claims 2-6 are supported in original claims 2-6.
- Amended claim 7 is supported in original claims 7 and 8.



- Original claim 8 has been deleted and the subject matter thereof has been included in amended claim 7.

When reviewing the description and claims for making the amendments, we also made some clerical self-evident amendments aimed to improve the language of the application and to correct some minor errors.

**(1.2) The amendments in the description are as follows:**

In original page 4, the text in lines 3-5 has been completed.

In original page 5, line 19, the reference to figure 2 has been corrected for the reference to figure 3.

In original page 2, after line 9, a brief description of the identification and discussion of documents D1 and D4 has been inserted.

In figure 2, the numerical reference 7 has been modified as marked, due to it was pointing to an erroneous element in the drawing.

**(1.3) The amendments in claims are as follows:**

**Claim 1**

A short recitation of "the conventional elements" which has been inserted now – paragraph identified with reference <A> in the explanatory sheets 7 and 7a- explicitly defines which these elements are.

Within the same paragraph reference <A> it has been included a new wording regarding one of the ends of all elements being connected to ground level; as per examiner's suggestion, claim 1 now clearly discloses that "...each of said conventional elements has a first end and a second end opposite to the first end, with the first ends of all elements connected to ground level..."

**Claims 3 and 5**

The "the low voltage input" –in claim 3- and "the high voltage switches" –in claim 5- have now antecedent basis on the recitation of the conventional elements introduced in the amended claim 1.

Original claim 8 has been deleted given that the subject matter has been included in claim 7.

**(1.4) Amendments throughout the entire text of the application:**

The term "tension" has been replaced by "voltage" as per examiner's suggestion.

The term "barrier" has been replaced by "solid insulating means" to avoid the vague



and indefinite term "barrier".

The wording "at and equal level or distance" has been replaced by "at an equal distance" to avoid a lack of clarity pointed out by the examiner.

Some numerical references in the description and abstract have been inserted.

**(1.5)** In view of the above, it is submitted that the amended claims and amendments in the description as submitted herewith, are directly and unambiguously derivable from and do not extend beyond the disclosure of the present application as originally filed, and they are thus admissible.

**(2)** The original claims 1-3, of the present application were objected for lacking novelty over the disclosures of D1.

Amended claim 1 as submitted herewith is considered to define subject matter which is novel and inventive because of the following reasons:

Document D1 discloses a high voltage transformer and rectifier arrangement. Said transformer comprises a secondary winding, divided into a plurality of sections, around a primary winding of the air-core type and first and second diode groups disposed on substrates which surround the secondary winding.

**(2.1)** Document D1 also describes a transformer wherein there is a plurality of positive and negative voltage windings, but in the arrangement of said windings in document D1 –one group following the other- it cannot be seen in any figure nor it is disclosed in the description or claims of said document, any insulating mean to isolate the positive voltage windings from the negative voltage windings; in the reference made by the examiner –col. 1, lines 15-16- it can be found that the bridge consisting of rectifiers, the first and the second windings are dipped in an insulation oil in a tank, but it is never shown that this insulating means constitute the insulating means between the positive and negative voltage windings, because in document D1 said positive and negative windings are one followed one by the other, whereas in the present application said positive and negative windings are located in two different and isolated chambers, the positive voltage windings are arranged in one column and the negative voltage windings are arranged in a different column, said chambers being isolated by solid insulating means.

This feature was already included in original text in line 7 of claim 1. In amended claim 1 the insulating means has been specified as a "solid insulating means" to be consistent with the rest of the amendments made, given that the term "barrier" was unclear.

**(2.2)** Another advantage of the present application over document D1 is the fact that the point where all elements are connected –ground level- is easily accessible in the present application as it is explicitly shown in the figures, and this precisely owing to the arrangement of the positive and negative voltage windings in two different and isolated columns.



**(2.3)** Regarding claim 3, document D1 does not disclose nor can be seen in any of figures 1, 2, or 3 that low voltage input signals connections be made on zero voltage level, but these connections are made at the starting ends and finishing ends of said windings –document D1, in column 3, lines 9-11 describes that "Leads are taken from respective winding start ends and winding finishing ends".

**(2.4)** Document D1 discloses a high voltage transformer with a **full-wave** rectifier arrangement whereas the present application "can be used in all those applications where a high kilovoltage supply is being required, **both in direct and in high or low frequency alternate current**" –page 1, lines 6-9.

**(2.5)** In figure 2 of the present application it can be seen that a large amount of insulating means is saved:

"in horizontal planes": in each level of voltage there is no need to employ insulating means because all elements in each level are working at said same level: between all the components in the tank, namely the high tension transformers, the rectifiers, the filters, the resistive dividers, there is no need to use insulating means given that all these elements have the same voltage at the same distance from ground level.

The advantageous consequence of all what has been mentioned hereinbefore is that distances between different elements are reduced, which implies a reduction in the size of the tank, which in turn implies a reduction in the volume of oil, which leads to a drastic reduction in weight –this fact is described in original page 6, lines 10-19 of the present application.

In view of the above, it is submitted that the invention as now claimed is novel, unobvious and unexpectedly advantageous, and thus patentable over D1.

**(3)** It is submitted that all amendments are self-evident and unambiguously derivable from the original disclosure.

**(4)** Favourable consideration of the present submissions is earnestly solicited. Should the examiner have further objections or objections to any of the amendments made, issuance of a corresponding second Written Opinion is requested. In view of the fact that the term until the IPER must be established will not expire until the 18th May 2001, sufficient time for issuance of such a second Written Opinion and a eventually filing a response thereto should be available.

Respectfully submitted,

Javier UNGRIA

Enc.: \*

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**COMPLETE TEXT INCLUDING ALL THE AMENDMENTS  
MADE DURING INTERNATIONAL PHASE**

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## HIGH VOLTAGE TRANSFORMER

OBJECT OF THE INVENTION

The invention that is being dealt with consists in a high voltage transformer the goal of which is to considerably 5 reduce the size and the price thereof.

Obviously, the invention can be used in all those applications where a high kilovoltage supply is being required, both in direct and in high or low frequency alternate current.

10

BACKGROUND OF THE INVENTION

Conventionally, the use of high kilovoltage transformers the design of which presents a maximum difficulty in achieving the electrical insulation between the various elements (transformers, high voltage switches, 15 rectifiers, voltage dividers, dischargers, etc.) they are composed of, is more than known. Insulation thereof is conventionally made by three different manners:

1. Filling, at vacuum and in a dry environment, the whole inside of the tank or housing containing the various 20 elements of the transformer with a liquid or gaseous fluid which is usually silicone oil or mineral oil due to the low cost thereof.

2. Using solid insulating parts as there are plastics, glasses, porcelains, resins, etc.

25 3. Vacuum encapsulating the whole assembly with high voltage insulating silicones or resins.

In any of these three manners of making the insulation, it is necessary to keep some minimum distances between the various elements composing the transformer. 30 This minimum distance depends on the voltage applied between the various elements so that it is necessary to keep a minimum insulation distance between the points of major voltage, which involves in the majority of the cases, the insulation distance becomes excessive for 35 achieving insulation between the points of minor voltage.

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The final consequence is that the elements occupy a very high volume, whereby this volume must moreover be covered with the insulating material, a fact which considerably increases the weight and, especially, increases the cost  
5 of the transformer.

Furthermore, this design for achieving minimum distances, renders the assembly of the various elements of the transformer difficult, a fact which equally increases its cost.

10 The United States patent 4,587,606 describes a secondary winding divided into a plurality of sections provided around a primary winding of the air-core type. First and second diode groups are disposed on four substrates which surround the secondary winding. Diodes in each of the first and second diode groups are disposed on two adjacent substrates so that these diodes are connected in series so as to have the same polarity direction, respectively.

20 The first and second diode groups are respectively divided into a plurality of diode sections. Winding start ends and winding finishing ends are coupled between the respective two adjacent diode sections.

25 The diode sections disposed on each substrate are arranged to be spaced apart along the axial direction of the primary winding. One of the diode sections to which induced voltages of the winding sections are applied is disposed on two adjacent substrates, and the other diode section is disposed on the other two adjacent substrates. Positions of these diode sections are shifted along the axial direction of the primary winding. Therefore, the diode sections to which the induced voltages of the winding sections are applied are disposed on different substrates and are not on the same plane.

30 The Japanese patent application 6333754 A describes a transformer for cycloconverter to provide a transformer  
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with equal factors of resistance and leakage reactance in positive and negative groups of windings.

5 In a first constitution, a conductor in a positive group winding and a conductor in a negative group winding are turned double in an axial direction on a core leg at the same time.

10 In a second constitution, the positive group winding and the negative group winding are put on separate divisions in an axial direction of the core leg. Then, a power-supply winding is split into two and they are mounted around each outer boundary of the positive and negative group windings.

#### DESCRIPTION OF THE INVENTION

15 To solve the afore indicated inconveniences, the invention has developed a new high voltage transformer which is characterized in that the conventional elements it is constituted of are arranged in two differentiated groups, on the one hand the elements having positive voltage and, on the other, the elements having negative voltages, both groups being separated by insulating means.

20 Furthermore, the arrangement of the elements provides that they are advantageously designed in such a manner that one of the ends of all thereof, have ground level or "zero" voltage. This voltage progressively increases 25 towards the opposed end in the elements having positive voltages, and progressively decreases in the elements having negative voltages; all this in such a manner that, at an equal distance from ground level, the elements of each group have equipotential voltages.

30 This structure has the great advantage that the elements of one same group do not need insulation between themselves, so that the distance which is to separate them is considerably reduced, and, furthermore, the elements occupying the same area of potential do not at all have an 35 influence on the stray capacitance, so that there are no

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limitations neither in respect of their proximity nor in respect of the opposed surfaces between them.

Thus, by means of the invention, as the elements are designed such that their voltage levels are in accordance with the area of potential which they occupy, it is possible to bring the elements nearer to each other, so that the volume is considerably reduced and, thus, the insulator filling the inside of the housing or tank of the transformer, is considerably reduced.

As a consequence of this reduction of the volume, a considerable reduction of the weight is achieved, due to the fact that the tank is of smaller dimensions and a smaller quantity of filling insulator is required.

Another of the advantages of the present invention is the reduction of the stray capacitance which eliminates some undesirable side effects.

The progressive increase of the voltage in the elements having a positive voltage, and the progressive decrease of the voltage in the elements having a negative voltage, are linear.

Advantageously, the ground level or "zero voltage", is located in the area where the low voltage input signals are located.

In a preferred embodiment, the "zero voltage" level is located on the upper side of the transformer, such that the maximum level of potential is defined at the lower ends of the high voltage switches.

The insulating means separating the two groups of elements, are established by one single solid insulating means, a fact which considerably simplifies the assembly of the various elements of the transformer at the same time as it reduces its cost.

Another feature of the invention resides in the fact that it has means for minimizing the stray capacitance between the elements of one group and the elements of the

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other. These means are determined by the arrangement presented by the various elements of one group and the other; said elements are located in such a way that the surface of the elements of one group opposed to the 5 surface of the elements of the other group, is minimum.

By means of the invention, the number of supporting and electrical insulation parts as well as manpower needed for assembling is reduced.

10 As a consequence of the above, it is evident that the invention considerably reduces the total cost of the tank, as well as that of the storage and transport thereof.

Hereafter, so as to facilitate a better understanding of this description and forming an integral part thereof, a series of figures in which the object of the invention 15 is represented in an illustrative, non-limiting way, is attached hereto.

#### BRIEF DESCRIPTION OF THE DRAWINGS

Figure 1 shows a schematic top plan view of a possible embodiment of the transformer of the invention. 20 In this figure the upper surface or cover of the housing or tank of the transformer has been removed.

Figure 2 shows a side view of the transformer shown in the preceding figure, in which the lateral surface has been removed so as to clearly appreciate the arrangement 25 of the various elements.

Figure 3 shows a view in accordance with section A-B of the preceding figure.

#### DESCRIPTION OF A PREFERRED EMBODIMENT OF THE INVENTION

Hereinafter, a description of the invention will be 30 made on the basis of the aforementioned figures.

The transformer of the invention presents as a characteristic the fact that the conventional elements it is comprised of, are arranged in two differentiated groups, in such a manner that, on one side, there are 35 situated the elements with positive voltages and, on the

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other, the elements with negative voltages.

For this purpose, in a longitudinal half of the transformer there are arranged: a high voltage transformer 1 with its magnetic core 7, a rectifier 2, a filter 3, a 5 resistive divider 4 and an anode switch 5 which constitute the elements supporting positive voltages.

In the other longitudinal half, there are arranged, a high voltage transformer 1' with its magnetic core 7', a rectifier 2', a filter 3', a resistive divider 4', and the 10 cathode switch 5' which constitute the elements supporting negative voltages.

Between both groups, there is arranged a solid insulating means (6) furnishing correct insulation between the two groups, whereas insulation between the various 15 elements of each group is achieved by means of a fixing to a "zero voltage" or ground level on the upper side, which is progressively increased towards the lower end in the elements with positive voltage and which progressively decreases in the elements with negative voltages, in such 20 a way that at one same distance from ground level, the elements of each group have equal voltages as represented in figures 2 and 3 wherein voltage levels of  $0 \pm 20\text{kV}$ ,  $\pm 40\text{kV}$ ,  $\pm 80\text{kV}$  have been marked.

Hereby, the potential becomes linearly increased as 25 from the level of 0 Volt downwards, whereby the maximum level of potential is defined by the lower ends of the switches 5 and 5'.

Achievement of equipotential levels permits the 30 elements occupying the same level of potential to be brought near to each other until almost contacting each other, as they do not need insulators and do not at all have an influence on the stray capacitance, and there are thus no limitations neither in respect of their proximity nor in respect of the opposed surfaces therebetween, so 35 that the total volume of the transformer is considerably

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reduced.

Furthermore, as can be appreciated in figure 1, the surface of the elements of one group being opposed to the opposite surface of the elements of the other group, is 5 minimum, such that the stray capacitances are minimized.

All described elements remain included in housing 8 which is closed at its upside by cover 9 constituting the point of zero voltage wherein low voltage input 10 is arranged. Said low voltage input is negligible when 10 compared to the high voltage being generated at the various levels, and can therefore be considered as zero voltage level.

As has been described before in chapter Background of the Invention, the inside of the tank or housing 8 is 15 filled with an insulating material which in the embodiment is silicone oil or mineral oil, and as a matter of example it may be pointed out that the amount of this insulator needed for filling the whole of the volume, is of 4 liters which in comparison to the 36 liters needed by 20 conventional transformers, represents a very high reduction in volume with the subsequent saving represented thereby.

Obviously, as already stated in chapter Background of the Invention, the insulator being used can be 25 materialized by means of vacuum encapsulating the whole of the assembly with high voltage insulating silicones or resins.

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CLAIMS

1. A high voltage transformer comprising the conventional elements for voltage transformers, said conventional elements being at least

5      a high tension transformer (1, 1'),  
       a rectifier (2, 2'),  
       a filter (3, 3'),  
       a resistive divider (4, 4'),  
       a high voltage switch (5, 5'),  
 10     a magnetic core (7, 7'),  
       a low voltage input (10).)

said high voltage transformer characterized in that, each of said conventional elements has a first end and a second end opposite to the first end, with the first ends of all elements connected to ground level, that is to say, zero voltage,

15     said conventional elements are arranged in two differentiated groups, on the one hand the elements with positive voltages (1-5 and 7) and, on the other, the elements with negative voltages (1'-5' and 7')

20     the elements with positive voltages (1-5 and 7) are separated from the elements with negative voltages (1'-5' and 7') by solid insulating means,

25     the voltage in each of said conventional elements progressively increases towards the opposed second end in the elements with positive voltages and progressively decreases in the elements with negative voltages, all this in such a manner that, at an equal distance from the ground level, the elements of each group have equipotential voltages.

30

2. A high voltage transformer according to claim 1, characterized in that the progressive increase of the voltage in the elements with positive voltage and the progressive decrease of the voltage in the elements with

35

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negative voltage, is linear.

3. A high voltage transformer according to claim 1, characterized in that the level of "zero voltage" is  
5 located in the area where the signals of the low voltage input (10) are located.

4. A high voltage transformer according to claim 3, characterized in that the level of "zero voltage" is  
10 located at the upper side (9) of the transformer.

5. A high voltage transformer according to any of the preceding claims, characterized in that the maximum level of potential is defined at the lower ends of the high voltage switches (5,5').  
15

6. A high voltage transformer according to claim 1, characterized in that the two groups are separated by a single solid insulating means(6).  
20

7. A high voltage transformer according to claim 1, characterized in that it includes means for minimizing the stray capacitances between the elements of one group and those of the other, said means being determined by an arrangement of said elements, such that the elements of one group have only a very small surface opposed to the elements of the other group.  
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